NIF

National Ignition Facility

Why Do We Need LIFE?

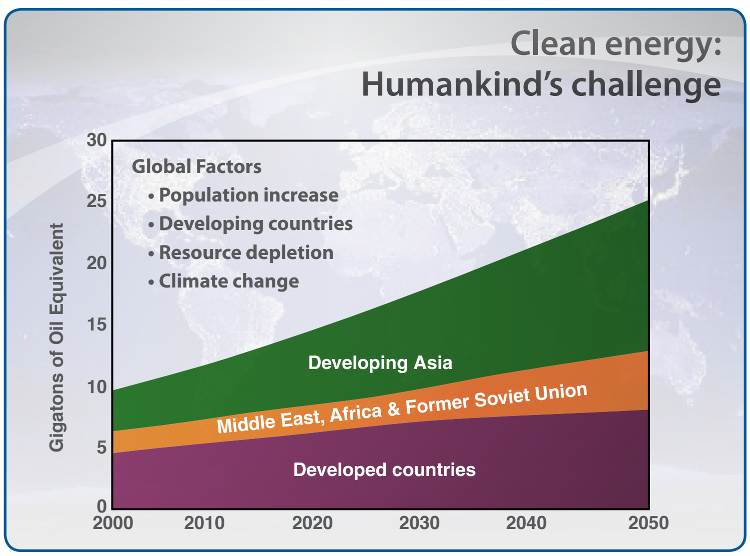
Providing for the world's energy needs and disposing of dangerous nuclear materials are two of the most urgent – and difficult – challenges facing today's society.

Worldwide electric power demand is expected to double from its current level of about two trillion watts (TW) to four TW by 2030 and could reach eight to ten TW by 2100. As many as 10,000 new one-gigawatt (GW) power plants will be needed to keep up with this demand.

Yet fossil-fuel supplies, such as coal and natural gas, are limited, and the environmental effects of that many additional fossil-fuel plants could be devastating. Conventional nuclear power could provide clean energy, but poses waste-disposal and proliferation concerns.

Rising Energy Demand

The anticipated growth in global energy consumption is driven by population growth and the increasing demand for energy in the developing world.



All available energy options have limitations and liabilities, so revolutionary responses must be pursued in parallel with evolutionary ones. The Laser Inertial Fusion Engine, or LIFE, is one such revolutionary response to both the energy and nuclear waste issues.

Safe, Sustainable, Carbon-Free Energy

LIFE is well suited to meet the energy demands facing our nation and our planet. Although technical challenges must be overcome, the fusion-fission LIFE engine concept provides a path to a sustainable energy future based on safe nuclear power with minimal nuclear waste per gigawatt of electricity generated. By the end of the century, LIFE could provide into the existing grid about half of U.S. baseload electricity demand. Spent nuclear fuel from light-water reactors (LWRs) could provide fuel for LIFE for the next 200 years, and depleted uranium from the LWR fuel-enrichment process could power LIFE engines for more than 1,000 years.

A LIFE power plant can provide carbon-free power, and thus would be an excellent baseload complement to solar and other renewables better suited for meeting peak load demands. Since LIFE uses so little fuel, it also operates with a small environmental footprint.

Livermore projections show that the cost of producing electricity from the LIFE engine should be competitive with the projected cost of electricity for advanced nuclear power plant options envisaged for the 2030 time frame and beyond. These projections were made by comparing the estimated capital costs of the laser and fusion targets required for LIFE with cost savings achieved by operating a subcritical fission blanket, eliminating uranium enrichment and multiple fuel reprocessing and recycling steps, and reducing the need for long-term waste repositories. LIFE also avoids costs faced by other new energy technologies, such as new grid infrastructure costs.

Because the cost of LIFE power is likely to be competitive, it can be used as a source of power for providing transportable fuels. If

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gasoline cars were replaced with plug-in hybrid cars, LIFE could provide the electricity needed to charge them. If gasoline were replaced with hydrogen, LIFE power could be used to produce the hydrogen. And if gasoline were replaced with biofuels, LIFE could power the equipment used to convert biomass into fuel. LIFE could also be configured to use its process heat to power material and other manufacturing processes.

LIFE engines have an important advantage – a virtually limitless supply of fuel. This comes from the enormous fuel flexibility of a LIFE engine: It can use a wide range of materials as fuel, including current nuclear fuels, depleted uranium and other materials commonly considered to be nuclear waste. The U.S. supply of these materials is extensive and, if the estimated supplies of natural uranium and thorium are included, they could be used to meet the country's energy needs for many thousands of years.

Another attractive feature of LIFE in contrast to traditional fission reactors is its subcriticality – the fissile fuel in a LIFE engine could not spontaneously generate enough neutrons to start or maintain a nuclear chain reaction. This could ease regulatory requirements, reduce development and implementation costs and delays and make the technology potentially more attractive to private industry.

Finally, LIFE provides the current LWR-based nuclear energy industry with an option to expand now, knowing that a future technology capable of mitigating the long-term nuclear waste and proliferation concerns associated with the current open fuel cycle is well within reach in the first half of this century. The LIFE design ultimately offers many advantages over current and proposed nuclear energy technologies and could well lead to a true worldwide nuclear energy renaissance and sustainable energy security for the future.

Hydrogen Storage Tank

LLNL researchers Salvador Aceves and Tim Ross examine an LLNL-developed on-board hydrogen storage tank that powers a prototype hybrid vehicle.